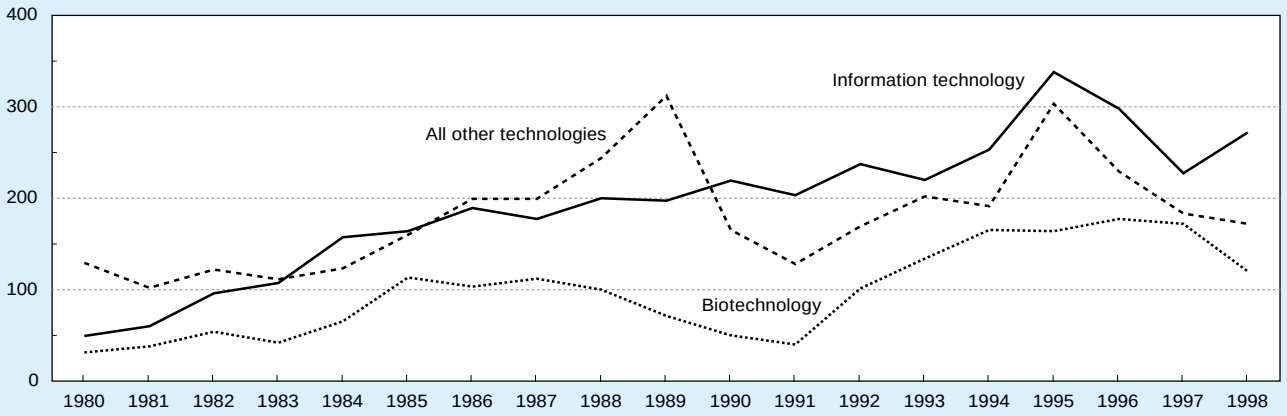
Figure 2-36.
New international strategic technology alliances, by technology



NOTE: Includes alliances of firms located both within broad regions and across broad regions.
See appendix table 2-67.

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ported during the entire 1980–98 period (a figure that includes double-counting of partnerships with two or more European firms), the most active participants were British firms (1,036 alliances), German firms (994), French firms (715) and Dutch firms (680). More than 100 alliances were also formed by companies with Italian (338), Swiss (267), Swedish (278), and Belgian (119) ownership. Additionally, a substantial number of the international technology partnerships involved firms located outside of these major regions. During the entire 1980–98 period, Canadian firms entered into 198 strategic technology alliances (mostly with U.S. companies), South Korean firms joined 119, Russian (and other former Soviet Union) firms joined 90,[57] Chinese firms joined 86, Australian firms joined 63, Israeli firms joined 51, and Taiwanese firms joined 48.

Technology Focus

Most intraregional and interregional alliances have been between firms sharing research and technology development in information technologies (IT) and biotechnology. These two technologies alone account for two-thirds of all alliances formed since 1990. The only other technologies for which firms consistently have entered into a substantial number of partnerships relate to advanced materials and non–biotechnology-based chemicals. (See appendix table 2-67.) Forty-four percent of the technology alliances formed worldwide since 1990 dealt with information technologies such as computer software and hardware, telecommunications, industrial automation, and microelectronics. Of the roughly 2,300 IT alliances formed during this period, most have been between U.S. companies (50 percent) or between European and U.S. firms (19 percent). Among the 1,100 strategic biotechnology alliances, the regional distribution has been more diverse, although U.S.-U.S. and U.S.-European interregional partnerships are more prevalent than any other (each type accounting for more than one-third of the biotechnology total). Consistent with R&D funding trends and indicative of known core strengths, U.S.-Japanese collaborations are more common in IT activities than in biotechnology.

International Industrial R&D Investment Growth

Stiff international competition in research-intensive, high-technology products and market opportunities have compelled firms throughout the world to expand their overseas research activities. Foreign sources account for a growing share of domestic R&D investment totals in many countries. (See figure 2-32.) Many firms have R&D sites in countries outside their home base. Although the data are somewhat scant, the share of R&D performed by foreign affiliates appears to have risen perceptibly throughout the OECD during the past two decades (OECD 1998a). Currently, the share of R&D performed by foreign affiliates accounts on average for 14 percent of the industrial R&D performed in OECD countries. This share varies considerably among hosting countries, however—from a low of 1 percent in Japan to a high of 68 percent in Ireland (OECD 1999d).

Although many factors contribute to a business decision to locate R&D capabilities outside a firm's home country, the basic drivers fall into demand-side and supply-side considerations.

Multinational firms seek a foreign R&D presence to support their overseas manufacturing facilities or to adapt standard products to the demand there. R&D facilities are established to customize existing products or to develop new

[57]See Hagedoorn and Sedaitis (1998) for summary data on international strategic technology alliances between Western companies and Russian companies.

Text table 2–18.
Strategic Technology Alliances, by region: 1980–98

	Total alliances	Information technology	Biotechnology	All other technologies
1980–1989 alliances				
Total	3,826	1,396	729	1,701
USA-Europe	809	296	152	361
USA-Japan	550	209	93	248
USA-Others	178	44	23	111
Europe-Japan	237	84	24	129
Europe-Others	188	55	15	118
Japan-Others	53	8	8	37
Intra-USA	908	400	247	261
Intra-Europe	670	242	125	303
Intra-Japan	233	58	42	133
Percent of 1980–1989 totals				
Total	100.0	100.0	100.0	100.0
USA-Europe	21.1	21.2	20.9	21.2
USA-Japan	14.4	15.0	12.8	14.6
USA-Others	4.7	3.2	3.2	6.5
Europe-Japan	6.2	6.0	3.3	7.6
Europe-Others	4.9	3.9	2.1	6.9
Japan-Others	1.4	0.6	1.1	2.2
Intra-USA	23.7	28.7	33.9	15.3
Intra-Europe	17.5	17.3	17.1	17.8
Intra-Japan	6.1	4.2	5.8	7.8
1990–1998 alliances				
Total	5,132	2,267	1,123	1,742
USA-Europe	1,284	434	403	447
USA-Japan	437	259	66	112
USA-Others	254	113	44	97
Europe-Japan	195	75	32	88
Europe-Others	174	50	33	91
Japan-Others	40	22	5	13
Intra-USA	2,150	1,140	436	574
Intra-Europe	521	142	100	279
Intra-Japan	77	32	4	41
Percent of 1990–1998 totals				
Total	100.0	100.0	100.0	100.0
USA-Europe	25.0	19.1	35.9	25.7
USA-Japan	8.5	11.4	5.9	6.4
USA-Others	4.9	5.0	3.9	5.6
Europe-Japan	3.8	3.3	2.8	5.1
Europe-Others	3.4	2.2	2.9	5.2
Japan-Others	0.8	1.0	0.4	0.7
Intra-USA	41.9	50.3	38.8	33.0
Intra-Europe	10.2	6.3	8.9	16.0
Intra-Japan	1.5	1.4	0.4	2.4

See appendix table 2-67.

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products for the local market. Additionally, such facilities may provide technical service support to local manufacturing activities as their primary purpose. In some situations, however, the location of R&D facilities is the price of entry to the local market. These arrangements constitute a home-base exploiting site, where information tends to flow to the foreign laboratory from the central home laboratory.

Conversely—and more commonly of late—the foreign site is established to tap knowledge and skilled labor from competitors and universities around the globe, including the direct employment of local talents; to participate in joint research ventures and cooperative agreements; and to passively monitor technological development abroad. These facilities have the characteristics of a home-base augmenting site, where information tends to flow from the foreign laboratory to the central home laboratory. Generally, however, there is little evidence to suggest that firms go abroad to compensate for their R&D weaknesses at home. Rather, they locate in foreign cen-

ters of excellence to supplement their existing core strengths (Patel and Vega 1999).

According to a study of 238 foreign R&D sites, 45 percent of the labs were home-base augmenting and 55 percent were home-base exploiting (Kuemmerle 1997).[58]

U.S. and Foreign Industrial R&D Expenditure Balance

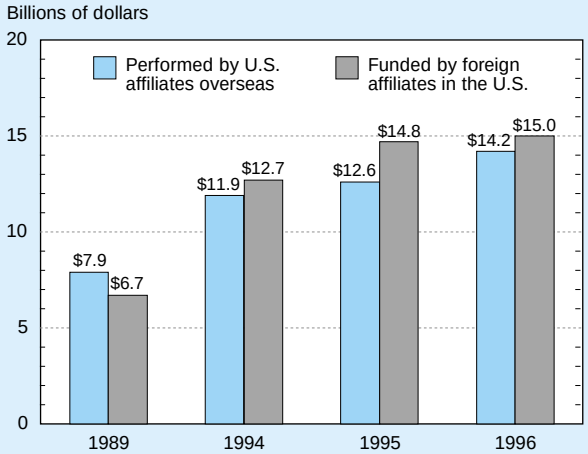
U.S. companies' R&D investments abroad are roughly equivalent to R&D expenditures in the United States by majority-owned U.S. affiliates of foreign companies.[59] In 1996 (the latest year for which complete data from the Bureau of Economic Analysis [BEA] are available at this writing), industrial R&D flows into the United States totaled $15.0 billion, compared with $14.2 billion in R&D expenditures by U.S. multinational firms in other countries. (See figure 2-37.) This approximate balance in R&D investment flows has persisted since (at least) 1989, when the majority-owned data first became available on an annual basis. In 1989, however, U.S. companies conducted a greater amount of R&D abroad than was invested in the United States by foreign firms. The reverse now appears to be true: More industrial R&D money is flowing into the United States than U.S. firms are performing abroad. Whatever the exact "balance" in any given year, however, higher levels of U.S. R&D investment in foreign economies and non-U.S. R&D investment within the U.S. domestic economy clearly are becoming the norm (Mowery 1998a).

Europe is the primary source and the main location of performance of these U.S.-foreign industrial R&D flows. (See figure 2-38.) European firms invested $11.2 billion of R&D money in the United States in 1996; the Asian (excluding the Middle East) and Pacific region provided the second largest source of foreign R&D funds ($1.9 billion). Similarly, foreign affiliates of U.S. companies performed $9.7 billion of R&D in Europe and $2.1 billion in Asia and the Pacific region.[60] Industrial R&D investments between Canada and the United States are in the $1.5 billion range. U.S. industry's R&D flows remain relatively small (less than $1 billion) into and out of Latin America and the Middle East and are negligible with Africa.

[58]The terms "home-base exploiting" and "home-base augmenting" are taken directly from Kuemmerle (1997). Others, however (e.g., Mowery 1998b and Dalton, Serapio, and Yoshida 1999), have made similar observations on the reasons for expanding global R&D arrangements. Furthermore, Mowery notes that the use of international R&D strategies to establish networks for the creation and strengthening of firm-specific technological capabilities (i.e., home-base augmenting) is likely to become more important than market exploitation-driven activities in the future.

[59]These overseas R&D data are from the BEA survey on U.S. Direct Investment Abroad. The definition used by BEA for R&D expenditures is from the Financial Accounting Standards Board Statement No. 2; these expenditures include all charges for R&D performed for the benefit of the affiliate by the affiliate itself and by others on contract. BEA detail is available for 1982 and annually since 1989. Data on foreign sources of industrial R&D performed in the United States come from an annual survey of Foreign Direct Investment in the United States, also conducted by BEA. BEA reports that foreign R&D totals are comparable with U.S. R&D business data published by NSF. Industry-specific comparisons, however, are limited because of differences in the industry classifications used by the two surveys (Quijano 1990).

Figure 2-37.
Globalization of U.S. industrial R&D



NOTE: Data for majority-owned (50 percent or more) non-bank affiliates only.

See appendix tables 2-69 and 2-71.

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Trends in U.S. Industry's Overseas R&D

From 1985 through 1996, U.S. firms generally increased their annual funding of R&D performed outside the country more than their funding of R&D performed in the United States. (See appendix table 2-68.) Indeed, during this period U.S. firms' investment in overseas R&D increased 2.8 times faster than did company-funded R&D performed domestically (9.7 percent versus 3.4 percent inflation-adjusted average annual growth). Overseas R&D funding accounted for about 6.0 percent of U.S. industry's total (domestic plus overseas) R&D funding in 1985; in 1996 overseas R&D accounted for 10.4 percent of U.S. industry's total R&D. In 1997, however, strong growth in U.S. companies' domestic R&D financing (up 10 percent), coupled with a 7 percent decline in

[60]Analyses of the BEA data on overseas R&D activities of U.S. affiliates have become complicated as a result of a change in survey collection. Prior to the 1994 survey, BEA collected expenditure data on R&D funding by U.S. overseas affiliates regardless of whether the R&D was performed by the affiliate of by others. It excluded R&D conducted by the affiliate under contract for others. Beginning with the 1995 survey, U.S. affiliates were asked to report their R&D performance irrespective of the funding sources (i.e., they report R&D conducted in their own labs, including R&D funded by the affiliate itself and by others under contracts). R&D funded by the U.S. affiliate but conducted by other organizations are excluded. Consequently, the more recent BEA figures represent R&D performance of U.S. firms' foreign affiliates and not the foreign R&D funding made by U.S. firms.